

Build Your Own Solar Oven

Cooking with the Sun

Our sun is a constant source of energy. Each day, the sun bathes the Earth in unimaginable amounts of solar energy, most of which comes in the form of visible light. All over planet Earth, sunlight is the by far the most important source of energy for all living things. Without it, Earth would be lifeless.



The sun is the earth's most important source of energy.
Source: Corel Clipart Collection

Sunlight can be a practical source of energy for such everyday jobs as cooking, heating water, or warming up homes. The challenge is to find ways to transform sunlight into useable heat. The most efficient way to use heat from sunlight transform sunlight into heat is to shine lots of sunlight onto a dark surface. Dark surfaces absorb most of the visible light that falls upon them, and reflect very little. Visible light that is absorbed this way usually causes the dark-coloured surface to warm up. Of all colours, black is able to absorb the most light, and produce the most heat.

You are familiar with what happens to a dark-colored surface when sunlight strikes it: it will get warm. But without a little help, there is not usually not enough heat produced to cook foods. To produce enough heat for cooking, it is necessary to shine additional sunlight from a wider area onto the black

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surface. This is easy to do with mirrors or other reflective surfaces, or with glass or plastic lenses.



The completed solar oven.

The solar oven you will be building from this plan uses aluminum foil to gather sunlight. The foil-covered panels of the oven reflect sunlight into the cooking chamber, which is painted black. Heat is produced when the concentrated sunlight is absorbed by the black surface of the cooking chamber. The heat is contained inside the chamber with the help of insulation, and a clear plastic oven bag. The result is a great solar cooker and yummy food!

Solar Oven Safety

- Use extreme caution when cutting cardboard with the utility knife. Extend the blade only as far as is needed to cut through the cardboard, and lock it into place. Do your cutting on a cutting board or piece of scrap plywood, cardboard, or a kitchen cutting board.
- Use sunglasses when working with shiny materials in sunlight.
- Solar ovens can get very hot! Use oven mitts or gloves to prevent burns.



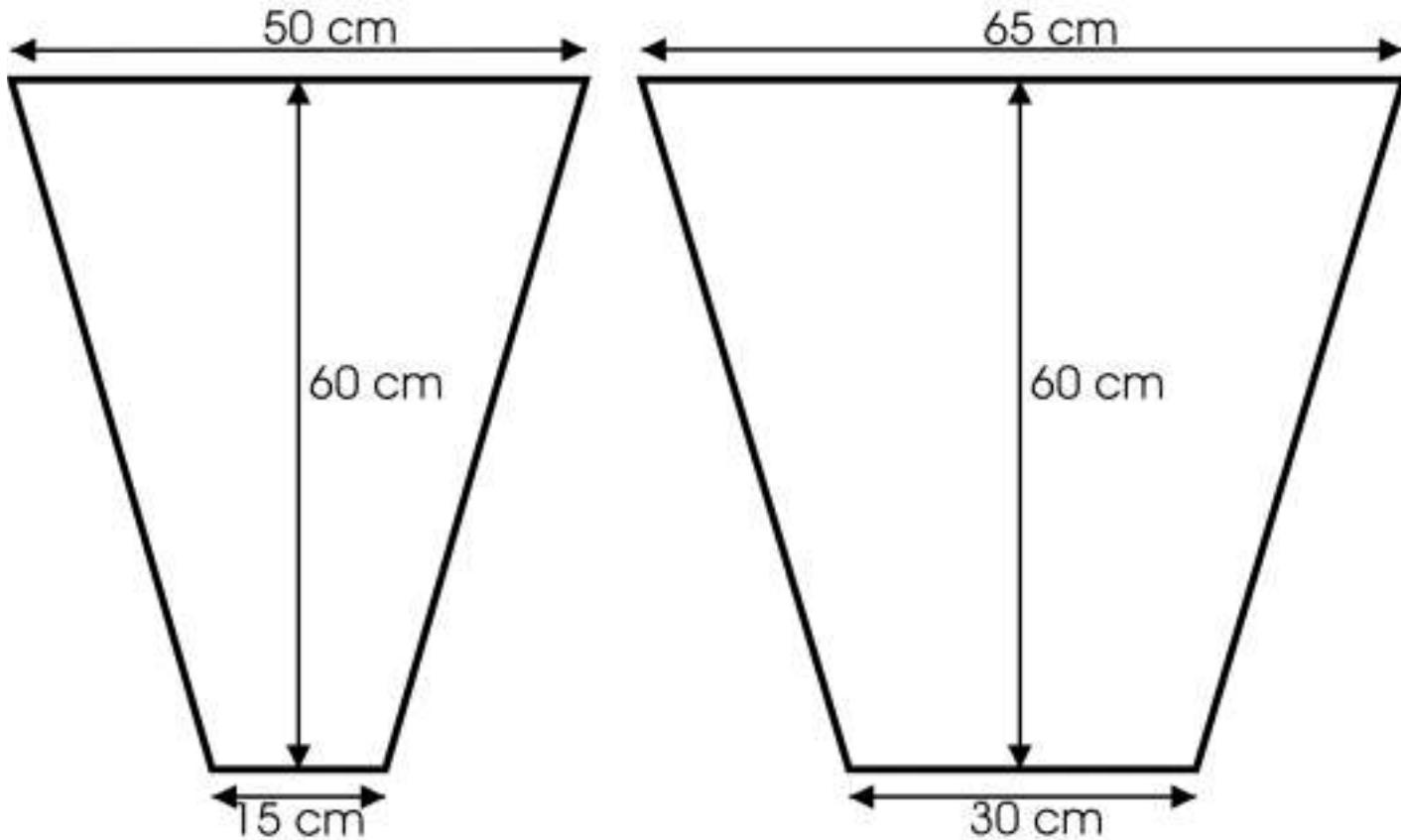
Solar oven construction materials.

Tools and Materials

- Corrugated cardboard (large flat sheets from appliance boxes work best)
- Duct tape
- Black tempera paint, powdered
- White glue
- Plastic container, approximately 500 ml
- Oven thermometer
- Aluminum foil (45.7 cm by 7.6 m roll)
- 1 Large aluminum foil cake tin (15 cm by 30 cm by 8 cm deep)
- 1 large (turkey- sized) transparent oven bag
- Shredded paper (for insulation)
- Cardboard box (with flaps, approximately 25 cm by 35 cm by 16 cm deep)
- Plastic spoon
- Utility knife
- Meter stick or metric tape measure
- Felt tip marker
- Sunglasses
- Paint brush, 3- to 5 cm wide
- Oven mitts

Solar Oven Reflector Plan

Cut two of each of these panels



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Measure and cut two each of these two panels from corrugated cardboard.

Build It!

A. Prepare the Reflective Panels

Organize your workspace. You will need a large tabletop to work on. It is very helpful to have a sink nearby for cleaning up. Arrange your materials and tools so you can get to them conveniently.

1. Using a meter stick and felt pen, draw the outlines of the reflector segments on your cardboard. Use the measurements on the blueprint template.
2. Using the utility knife, carefully cut out the 4 cardboard segments. Use a ruler or straight-edge to help guide your cuts. **CAUTION: Utility knives can be dangerous.** Extend the blade only as far as necessary to cut through the cardboard. Use some scrap cardboard or wood under the material you are cutting to avoid damaging the tabletop.
3. Remove the top from the white glue bottle and pour approximately 100 ml (about 1/3 cup) into the plastic container. Add 4 tablespoons of water to the glue and stir thoroughly. This will make the glue thinner and easier to spread evenly.
4. Carefully unroll enough aluminum to completely cover one section. Keep the foil as smooth and flat as possible. Wrinkles and creases in the foil will reduce the efficiency of the reflector. If the cardboard is wider than the foil, use two pieces of foil and plan to join them near the middle.
5. Using the paint brush, apply a thin layer of white glue over the entire surface of the cardboard. Be sure to spread the glue right to the edge of the cardboard. Use the flat edge of a piece of scrap cardboard as a squeegee to spread the glue out evenly.



Spreading glue on the cardboard.

6. Before the glue dries, place the foil on the cardboard shiny side up, and smooth it down over the entire surface. Try to press out any wrinkles, bubbles, or creases in the foil. If your foil gets badly wrinkled during the gluing process, tear it off and try again with fresh glue.



Smooth out the foil carefully, removing any wrinkles or bubbles as you go.

7. Using the utility knife, trim the foil so that it is flush with the edge of the cardboard all around. Set the panel aside to dry.
8. Repeat steps 3 through 5 for the remaining sections.
9. Rinse the paint brush thoroughly under the tap to remove any glue. The glue-water mixture can be used in Part D below, so put a lid on the container to keep the glue from drying out.

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B. Join the Panels

1. Cut 8 pieces of duct tape 60 cm long and set them aside (stick them to the edge of the table for easy retrieval).
2. Arrange the segments as shown in the photo below, foil side down, wide sections alternating with narrow ones. The narrow end of each should point toward you.



3. Carefully position the first two panels, keeping a 2 mm space between them. Position one of your 60- cm strips of duct tape over the joint between the panels. Press it onto the joint, being sure it sticks securely to both panels over its full length.



4. Join the third and fourth panels as in step 3 above.

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5. Carefully flip the joined panels over on the table. This may require two people. Reinforce the joint between each panel using another strip of duct tape.
6. Stand your reflector up (foil side in), bringing the edges of the outer two panels together. Have your partner hold the reflector in position while you add the last piece of duct tape.



7. Finish the last joint inside the reflector by applying the remaining piece of duct tape.

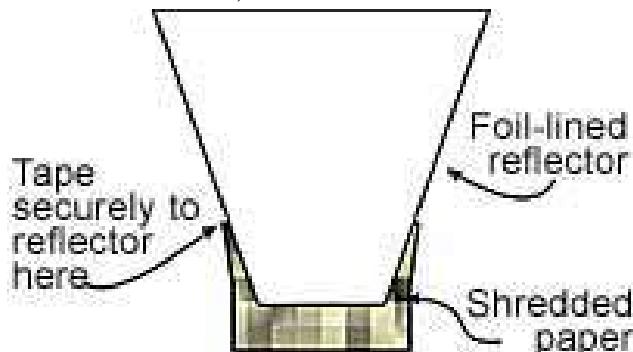
C. Add the Insulated Box

1. Using duct tape, fasten the cardboard box securely to the bottom of the reflector by its flaps. Be sure the box is centered. Add a few strips of duct tape to the corners to make the assembly more rigid.



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- Shred some newspaper by tearing it lengthwise into thin strips. You can also use paper from a mechanical paper shredder. Stuff shredded paper into the gaps between the box and the reflector. Leave a little of the paper on the bottom of the box, as shown in the illustration.



Insulate the box below the reflector using shredded newsprint.

D. Prepare the Baking Chamber

- In the plastic container, use your plastic spoon to mix 2 teaspoons of black tempera paint with one teaspoon of white glue, and two teaspoons of water (you can substitute glue and water from Part A above if you had any left over).
- Using the brush, apply the black paint evenly over the inside of an aluminum foil loaf tin. Set this aside to dry. It may be necessary to apply two coats of the paint to ensure full coverage of the aluminum.



Use two coats of black paint to coat the inside of the baking chamber.

Test It!

E. Test and Prepare the Solar Oven for Use

The solar oven is now ready to be tested. If the glue and paint are all dry and it is a sunny day, you can warm up your oven in preparation for its first cooking job.

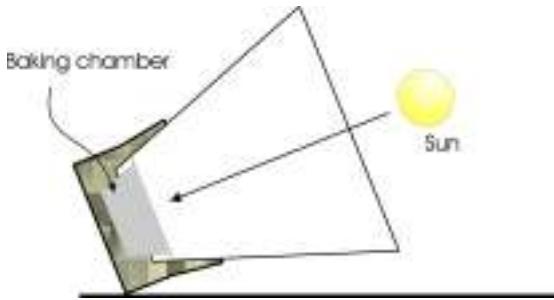
- Place the oven thermometer inside the painted baking tin.
- Slip the baking tin into the transparent plastic oven bag by placing the tin inside the oven plastic oven bag. Arrange the bag so that the plastic forms a smooth, unwrinkled window over the baking chamber.



Place the baking tin inside the oven bag.

- Press the baking chamber tightly into the bottom of the reflector.
- Outside, and with your sunglasses on, arrange your cooker so that the cooking chamber is fully illuminated by the sun. The diagram below shows you how to orient the reflector to get the most heat from the sun. You will need to prop the reflector up on some books, bricks, or other objects to keep it at the right angle.

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Position the oven so that the baking chamber faces the sun squarely and the shadow of the reflector is minimized.

5. If the day is sunny, clear, and warm, the temperature inside the cooker should begin to reach 100 degrees C or more within 20 minutes or so. Allow the cooker to reach its maximum temperature (about 200 degrees C or higher) and maintain that for an hour or more. This will burn off any unwanted substances inside the baking chamber.

F. Warming and Cooking Food with the Sun



- If your cooker reaches 100 degrees C, you can use it for heating foods. If it gets to temperatures of 175 degrees or higher, you can actually use it for baking.
- The plastic oven bag is extremely fragile and easily torn. Handle it carefully, especially when the cooking chamber is hot.

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- For cooking and baking, you will need to find small baking tins that fit easily into your baking chamber. To improve the baking efficiency, paint the OUTSIDE of any small baking tins you want to use with the same paint and glue mixture you used to blacken the inside of the baking chamber. Be sure to heat your painted tins in the oven without food to burn off any impurities before cooking with them.
- You can use your oven to bake brownies, cookies, muffins, bread, and other foods. You can also use your oven to warm soups, stews, pizza, and pastries using your cooker. You can also bake "veggie packs" of mixed vegetables such as carrots, broccoli, onions, and potatoes.
- You may need to support the pot or tin using small stones or metal jar lids to keep them level inside the baking chamber. Whatever you use in the baking chamber, make sure it is oven-safe and free from paints, solvents, plastics, and other substances that you do not want mixing with your food. If you are not sure whether something is oven-safe, ask a teacher, parent, or adult supervisor.

Questions

1. How could you increase the efficiency of this cooker? Describe 2 or 3 design changes that would help this cooker get hotter faster, and keep its heat better.
2. What is the purpose of having insulation (shredded paper) around the baking chamber?
3. What would happen if you painted the inside of the baking chamber white instead of black?

Contact us at: education@pembina.org



A Renewable Energy Project Kit

Another internet tool by: The Pembina Institute